

# Operations and Actions of Lie Groups on Manifolds

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## Abstract

As recounted in this paper, the idea of groups is one that has evolved from some very intuitive concepts. We can do binary operations like adding or multiplying two elements and also binary operations like taking the square root of an element (in this case the result is not always in the set). In this paper, we aim to find the operations and actions of Lie groups on manifolds. These actions can be applied to the matrix group and Bi-invariant forms of Lie groups and to generalize the eigenvalues and eigenfunctions of differential operators on  $\mathbb{R}^n$ . A Lie group is a group as well as differentiable manifold, with the property that the group operations are compatible with the smooth structure on which group manipulations, product and inverse, are distinct. It plays an extremely important role in the theory of fiber bundles and also finds vast applications in physics. It represents the best-developed theory of continuous symmetry of mathematical objects and structures, which makes them indispensable tools for many parts of contemporary mathematics, as well as for modern theoretical physics. Here we did work flat out to represent the mathematical aspects of Lie groups on manifolds.

## Keywords

Group ( $G$ ), Abelian Group ( $g_1 g_2 = g_2 g_1$ ), Subgroup ( $H$  is a Subgroup of  $G$ ), Co-Sets ( $gH$ ), Lie Groups ( $G \times G \rightarrow G(x, y) \mapsto x \cdot y$  and  $G \rightarrow G, g \mapsto g^{-1}$ ), Smooth Mapping ( $\sigma: G \times G \rightarrow G$ )

## 1. Introduction

In the present era, the study of the group related to the Lie group is essential for the sake of its comprehensive applications in several fields. Through the mathematical analysis, representations of groups on the manifold are vital due to its al-

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